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## ORIGINAL MEMORANDUM

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# TUBERCULAR CONDITIONS OF THE SPINE RE- QUIRING SURGICAL AND MECHANICAL RELIEF.<sup>1</sup>

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OF the tubercular and inflammatory conditions which affect the spine, the most common pathological process encountered is that mixed infection, tubercular and inflammatory, which is the result of spinal caries.

The most prominent surgical measures employed for the relief of this condition are: 1. Laminectomy for Paraplegia; 2. Forcible Immediate Straightening of the Kyphosis; 3. Forcible Gradual Straightening of the Kyphosis; 4. Erasion of Carious Bone; 5. Wiring of the Spinous Processes; 6. Evacuation of Pus Accumulations.

1. *Laminectomy*.—In the majority of cases, especially in children, the carious process may be arrested and a cure effected by rest, hyperextension, and fixation of the diseased area for a long period of time; yet in a certain number of instances a deposit of tubercular material within the spinal canal, enveloping and pressing upon the spinal cord, produces partial or complete paralysis of motion and sensation. Following this tubercular deposit an ascending or descending pachymeningitis may result, with permanent thickening of the membranes sufficient to interfere permanently with nerve transmission. Pus formation may still further interfere with function. Added to the pressure already alluded to may be bony pressure from caries of the vertebral bodies, thus angulating the canal, and in some instances narrowing the caliber by actual bony encroachment. In 98 per cent. of the cases, however, the

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<sup>1</sup> Read before the American Surgical Association, July, 1905.

diminution of caliber and the interference with nerve transmission are due to the first-named causes, while in only 2 per cent. is compression due to bony pressure. This fact is readily appreciated when it is noted that some of the worst cases of spinal caries paraplegia are those in which the kyphosis is moderate or even small, and again that paralysis is absent in cases of most marked posterior angularity. The region of the spine most prone to yield the paraplegic complication of spinal caries is the upper dorsal, where the bony canal is limited in size, and where even a small amount of intraspinal deposit yields most serious consequences. The clinical experience of every surgeon, however, has taught him that even a severe grade of paraplegia may recover, although great angularity still exists, provided the tubercular and inflammatory deposits are absorbed. The amount of paralysis and the consequent symptoms will depend upon the position, extent, and character of the tubercular deposit. A child affected with spinal caries begins suddenly or slowly to show evidences of feeble locomotion; loss of sensation; increased knee-jerks and ankle clonus; rigidity of limbs; gradual contraction of some group of muscles; frequently, loss of control of sphincters of bladder and rectum; sometimes priapism, persistent and painful. Fifteen or twenty years ago the exceptionally good results secured in a few cases by Macewen, Horsley, Lauenstein, and others, encouraged us to hope that in laminectomy we had found a speedy method of relief. Unfortunately, larger and fuller personal experience has demonstrated that while a few cases are permanently benefited by operation, yet that the mortality is high, and, even when temporary improvement takes place, relapses were common and permanent benefit uncertain.

The operation, therefore, while it has not been abandoned, has, like trephining of the cranium for epilepsy, been limited in its application and made secondary to other measures. Those measures have for their object the arrest and lessening and limitation of the bony destructive process and the permanent bridging and repair of the destroyed vertebral bodies. Added to these should be the employment of all the hygienic

measures available. Among the latter it is unnecessary to say that sunlight and fresh air hold the first places. In my experience, the prognosis in spinal caries paraplegia under so-called conservative methods has been so successful that I hesitate, save in very exceptional cases, to recommend operative procedures until other measures have failed. Thorough and complete rest, fixation of the diseased area, and progressive forcible straightening have yielded such good results that I have now many cases walking the streets which for a period of more than a year seemed incurable. I am inclined to prolong the treatment even to two years, when signs of improvement are evidenced. Of course, to be effectual, the rest should be absolute, the diseased vertebræ being so fixed that motion of the diseased bones is reduced to a minimum. This can be accomplished by head extension in bed, by hyperextension upon a Bradford or Goldthwaite frame, by plaster of Paris, or other fixed dressing to the spine. Internally, the iodide of potassium and iodide of iron are helpful, but rest and fixation are the prime elements in the cure. Should the paralysis continue beyond eighteen months or two years, the removal of the laminæ may, however, assist in the relief of the paraplegia, especially when the cord can be cleared from tubercular deposits. The mortality is unfortunately so high that after many years of test I find myself resorting less frequently than formerly to laminectomy for caries paraplegia, while in traumas of the spine I am more and more convinced of the benefit of early interference. When the vertebral bodies are carious, a laminectomy removes the only remaining healthy portion of the vertebræ, and to a considerable extent weakens the column. The advantage of laminectomy is that it removes pressure from structures each fibre of which is necessary for vital function, while in the brain, individual cells are not so essential. Although asepsis has greatly diminished the dangers of the operation, yet in a certain number of cases laminectomy opens the way for spinal infection, and the results of the pachymeningitis remain or are increased. Fortunately, the pachymeningitic deposit in some cases will be found localized and can be removed.



If the bony angulation with pressure in front of the cord were the chief cause of the loss of motion and sensation in the lower extremities, it would certainly be wiser to push our operative results to a greater degree, even to the extent of severing the spinal nerves in order to reach the source of trouble in front of the cord and then to reunite these nerves. An immediate mortality of 25 per cent. is very high, especially in a disease which is not in itself necessarily fatal, particularly as this rate is augmented during the first month by other deaths reaching more than one-third. If to this mortality be added those late deaths that are not directly the result of the operation, yet follow within a year, we find that at least in one-half of the cases life has been shortened. Final results following laminectomy are exceedingly difficult to obtain, since caries is a disease in itself, one that has to be judged by years not months, and an early report is valueless. The published reports would indicate that 65 per cent. may reasonably be placed to the credit either of deaths or of not having been materially or permanently improved. Naturally, however, these patients were all serious cases at the time of the operation.

A few words in regard to technique. Incision to one side of the dorsal median line, the cutting off of spinous processes and pushing them to one side, lessens hæmorrhage. Hæmorrhage and the removal of the first laminal arch constitute the delays in the operation. Many hæmostats and very hot packing should be at hand. Many surgeons prefer cutting bone forceps for taking away the first arch; I use either gnawing forceps or a Hey's saw. The fatty tissue and the ligament subflava are at first confusing, but as soon as the cord is exposed all hesitancy disappears. If the dura is yellow, there is probably pus within the membrane. A surgeon who has performed the operation only once or twice upon the upper portion of the spinal column realizes but little the difficulties and dangers of the procedure in the lower column. One danger of the operation is that blood leaking into the canal may cause additional compression and paralysis by travelling down the subdural space. Postmortems show that similar extravasations of blood

may take place on the cornua or on the columns, producing further paralysis. After secondary degenerations have taken place, improvement in the paralysis is not to be expected. One of the great dangers of laminectomy, especially low down, is the risk of later infection from bed-sores or from pus sinuses. The neuropathic bed-sores are especially dangerous from the extent of the trophic changes, while leakage of infected and decomposing urine is also most serious. Laminectomy is much less hopeful in spinal caries than in fractures and other traumas, since pachymeningitis, compression myelitis, or meningomyelitis may all be present in the former. All undue handling, even sponging of the cord, adds to the shock. The cord may be rolled to one side, but any extensive bone erosion is to be accomplished from the side, not across the cord space. If nerve-roots are injured, they should be sutured. When the extradural deposit is considerable and its removal possible, the dura should not be opened, as any fissure in this membrane is liable to permit tubercular infection within the membrane. To sum up, then, the dangers of laminectomy are its high mortality from shock and hæmorrhage, infection, suppuration, extension of myelitis or pachymeningitis, failure to permanently relieve, and weakening of the column. The advantages are the removal of tubercular masses in the canal, the removal of pachymeningitic deposits and of pus, the relief occasionally of anterior bony pressure, and, lastly, allowance for posterior expansion. In some instances marked benefit results both as regards motion and sensation. Relief of vesical symptoms alone well repays.

2. *Forcible Immediate Straightening of the Kyphosis.*—The method of immediate forcible straightening of the spine by hand pressure, as revived by Calot, the patient lying prone with pelvis and shoulders elevated upon blocks, is simply a new form of the barbaric methods practised before the time of Hippocrates. In those days a man's feet were bound to a ladder, and he was then dropped head downward from the top of a building. In other cases a long beam was used as a lever, with the kyphotic spine as the fulcrum, by which method,

of course, it was easy to crush any amount of deformity into the straight line. Hippocrates states that this method was employed "by those physicians who seek to astonish the mob and never give themselves any concern as to the result of the procedure, whether good or bad."

Looking at the operation both pathologically and clinically, it is unsurgical and unscientific. Upon its revival, I preferred that other surgeons should try it rather than myself, and I have never had occasion to change this opinion. I have resorted to the procedure a few times in old hopeless cases, but the operation has died the death to which it was entitled. To break up an already ossified bridge and leave a carious gap certainly is not conducive to the strength of a column; if pus is present, infection is probable. It has been shown pathologically that the material thrown out in the process of repair does not contain sufficient calcium salts or bone-producing material to give proper strength to the new bone. Since a cure can only be expected by an ossifying osteitis and a fixation of the spinal column capable of sustaining the superincumbent weight of the shoulders and head, the effort aimed at should not be, as in the immediate forcible operation, to produce a gap in the front of the spine which experience has shown can never be fully filled, but to secure as large an amount of ossifying material as possible and a bridge of most secure pattern. While the muscles may for a time hold the spine in position, they must ultimately give way, and relapses commence after the removal of the support.

Cases in which advantage has been secured in the relief of paraplegia are undoubtedly where the cord pressure has been relieved by the altered straightening of the column: the disadvantages are insufficient support causing weakness of the spine; subsequent recurrence; dissemination of tubercular material; increase of disease by local injury; production of general tuberculosis; injury to the cord; fresh suppuration. In some cases the paraplegia has been rendered worse, and in one instance the wall of the abscess was ruptured sufficiently to admit tubercle bacilli into the mediastinum.





FIG. 1.—Screw upright for straightening kyphosis while plaster-of-Paris bandage is being applied for permanent fixation in hyperextended position. Plate is hinged, so as to be withdrawn flat through slit.



3. *Gradual Correction of the Deformity.*—Forcible hand pressure upon the kyphosis at varying periods or by using the hump as a fulcrum and bringing to bear upon it the weight of the body above and below the disease, is a much safer process than immediate fracture. The advantages gained by such straightening must be immediately fixed by the application of a plaster-of-Paris cast. By this method a small amount of gain is secured, but all that is justifiable or to be expected safely. It is undoubtedly true that a large proportion of so-called straightening of the spine is due not to actual improvement of the kyphosis, but to the alteration of the curves in other portions of the column. In forced lordosis, bringing the weight of the body upon the posterior region rather than upon the vertebral bodies, is probably a large element in the benefit secured. This is true whether suspension is used or whether the dorsal fulcrum is applied directly to the kyphosis. The recumbent position upon a curved frame and extension in bed with a pad under the kyphosis during the acute stage is the best method of preventing deformity; then fixation for a long period of time by some form of splint adapted to each particular region of the spine, that is, in the cervical region the head should be thoroughly splinted, not by suspension or by a jury-mast, but by prolongation of the steel uprights so as to hold the head firmly in position with rigid splints. In the upper dorsal the same method is necessary; in the lower dorsal or lumbar either a steel or leather or similar jacket may be employed. Success depends upon the careful and long continuance of retention appliance for a sufficient length of time to produce a strong bony bridge. With the screw elevation shown in Fig. 1, the kyphosis and the spinal column are forced into hyperextension while the gypsum is applied. The plate over the hump is protected by a large, loose, felt cloth pad, which remains. Before the plaster fully hardens, a slit is made over the plate, which latter is so hinged that it can be withdrawn through a small opening. This opening can be closed at once by patching with plaster. A muslin suspension sling answers a similar purpose (Fig. 2).

4. *Erasion of Carious Bone.*—Theoretically, the operation of erasion is a good one; practically, the anatomical difficulties encountered are well-nigh prohibitive to that absolute removal of all carious tissue which is so essential to a complete and rapid diminution of pus formation. Of course, as long as we have any dead bone remaining, the discharge will continue. If the disease were situated principally or simply in the posterior regions, of course removal would be easily accomplished; but since it is the bodies of the vertebræ that are chiefly diseased, the absolute removal of all diseased tissue is problematical. The bodies of the lumbar vertebræ are large

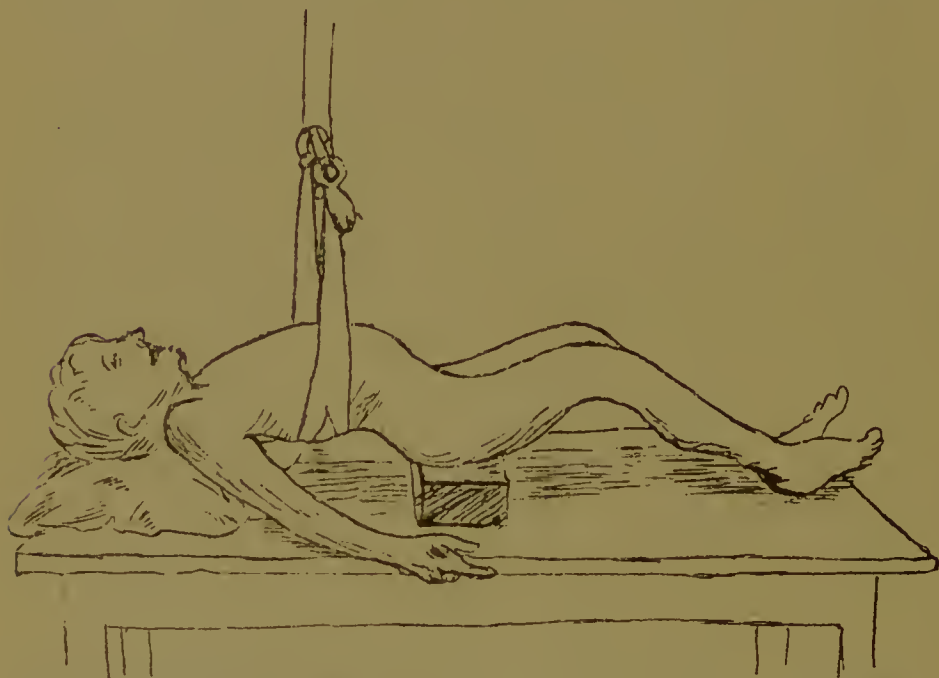


FIG. 2.—Muslin bandage for temporary suspension during application of gypsum. (Bradford.)

and lie far from the surface of the body; a careful inspection is impossible, and manual palpation fails to discern diseased bone from the roughened surfaces left by a gouge in cancellous tissue. One has but to examine a cross-section of a body as seen in formalin or frozen sections to note the difficulties of completely reaching and removing the entire body of the vertebræ even in a cadaver. In the dorsal region still greater difficulties are encountered. To reach the bodies, portions of

ribs must be excised, a costotransversectomy; the pleura lies in close proximity, and the wounding of this membrane opens new avenues for infection. The operation of erosion in this region is only applicable in cases where a large intrathoracic abscess has pushed the pleura forward and where manipulations can be conducted from inside the sac, a condition difficult to diagnose in advance. The twelfth dorsal can be reached from below through the psoas; but it should be remembered that the pleura is close at hand, sometimes extending as low as the liver and the transverse processes of the first lumbar. In the cervical region, a certain amount of diseased bone may be removed, but seldom all. In all these regions, therefore, the results are uncertain. The X-ray may assist in locating the disease, but even taken in connection with clinical symptoms is not positive. In the lumbar region too long an operation is not advisable, as the multitude of muscles, tendons, and strong fascia render the operation difficult, bloody, and uncertain. The immediate risks of the operation are considerable. To a certain extent, however, the suppurative process may be shortened by the amount of dead bone removed; the chief advantage gained is drainage.

5. *Wiring of the Spinous Processes*.—Wiring of the spinous processes as a means of inducing fixation of the column has been occasionally used, but not with sufficient frequency to determine its usefulness. Theoretically and mechanically the method seems only fairly helpful.

6. *Evacuation of Pus Accumulations*.—Surgeons vary in their methods of dealing with pus accumulations from spinal caries. Some still insist that cases progress more rapidly if the abscess is permitted to remain quiescent and to be absorbed or encapsulated. In some instances such a result is undoubtedly possible, but it is risky and usually unsuccessful. My own practice is to aspirate such accumulations so long as the liquefaction of caseation is drawn, but when the suppurative process is added to the tubercular, asepsis through drainage from spine to groin is best, provided subsequent cleanliness can be secured, a result which is undoubtedly possible with the exercise of constant vigilance.



## CONCLUSIONS.

1. Complete methodical and long-continued fixation of the spine in the position of hyperextension, with healthy surroundings in the sunlight, are the prime factors in securing new ossific deposit necessary to replace the carious bone.

2. Laminectomy for paraplegia is advisable only after long-continued and patient treatment along the above-named lines from one to two years, since the prognosis, especially in children, under these conditions is favorable, and good powers of locomotion may be confidently expected. The operation is justifiable in selected cases where loss of motion and sensation are progressively worse and the symptoms threaten life. If the tubercular masses within the spine can be removed, and if extradural pachymeningitic deposits or pus can be taken away, improvement may be expected, and in many cases relief occurs. The operation has a mortality of about 25 per cent. from immediate shock, 36 per cent. within a month; while one-half the cases die within the year, their lives being probably shortened by the operative procedure. Cases of non-improvement and death equal nearly 65 per cent.

3. Forcible immediate straightening of the kyphosis is an unsurgical and dangerous proceeding; it is liable to reawaken the tubercular disease and to weaken the column.

4. Forcible gradual straightening by supporting the kyphotic area upon a pedestal is a valuable agent in relieving deformity. The weight of the shoulders and pelvis can thus be utilized as straightening forces and the weight of the column thrown upon the posterior arches. In this position it is permanently fixed by plaster of Paris.

5. Complete erasion of the carious bodies of the vertebræ is an uncertain operation; in the dorsal region requiring section of ribs, with danger of wounding the pleura.

6. Wiring of the spinous processes has never been sufficiently tried to demonstrate its helpfulness.

7. Spinal abscesses which contain only liquefaction of caseation should be aspirated. When true pus has formed, aseptic through drainage is advisable.